Evaluation the Usage of Treated Shrimp Waste as Protein Source in Broiler Diet

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Abstract. The objective of the research was to know the best method of processed-shrimp wastes on protein consumption and retention. Experiment was designed using completely randomized design with five treatments of ration and four replications. Treatments were basal ration with added by 5% shrimp waste. Treatments were D_0 (basal diet + non treated shrimp waste), D_1 (basal diet + shrimp waste hydrolyzed by 3% NaOH), D_2 (basal diet + shrimp waste hydrolyzed by 6% NaOH), D_3 (basal diet + shrimp waste hydrolyzed by 5% H_2O_2), and D_4 (basal diet + shrimp waste fermented by *Aspergillus niger)*. The total number of treated chicken was 20 broiler of MB 202 strain. To compare the effect of treatments, data was analyzed using least square difference. Results showed that the treated shrimp waste had potential to use as protein source in broiler diet and the best consumption and retention protein was found in hydrolysis shrimp waste by 3% NaOH and 5% H_2O.

Key Words: shrimp waste, protein consumption, protein retention, broiler, *Aspergillus niger*

Introduction

The difficulty to obtain raw materials and how easy to get and cheap high-quality feed are constraints faced broiler poultry industry in Indonesia. Until now, the feed industry in Indonesia still relies on fish meal, meat and bone meal, soybean meal and waste soybean as raw material for source of protein. These materials are generally derived from imports whose prices are relatively expensive and volatile. Based on this, several studies have been conducted to look for alternative feed materials of local origin that can replace the conventional feed ingredients.

Some agricultural waste products or by-product of agriculture agro-industryes has great potential to be used as an alternative of protein sources (Nuraeni et al., 2005; Eruvbetine et al., 2003; Bath et al., 2001). Utilization of alternative feed ingredients will provide maximum impact if given properly to farm animals. Shrimp waste is one of the feed ingredients alternative for protein sources that have good potential (Gernat, 2001; Mahata et al., 2008). Shrimp waste containing 7.87% of water, 26.89% of crude fiber, 24.03% of crude protein, 5.14% of crude fat, 25.60% of ash, 16.69% of calcium and 930 kcal/kg metabolic energy (Mahata et al., 2008). Shrimp waste contains a complete amino acid (Kurtini et al., 2008). Research on the use of shrimp waste as a feed source of protein in broilers has been conducted by several researchers (Septinova et al., 2009; Djunaidi et al., 2009; Ingweye et al., 2008; Khempaka et al., 2006; Oduguwa et al., 2004; Okoye et al., 2005; Mahata et al., 2008).

However, the high protein content of feed ingredients are not yet a guarantee that the quality of feed materials is good as well because not everything that consumed by broiler can be utilized by the body. Therefore, to determine the quality of the feed material digestion retention value should be considered. Several factors affect the that value of the feed ingredients are: crude fiber, lignin, cellulose and the presence of substances that inhibit the nutrients to be absorbed by small intestine (Rofiq, 2003).

Based on digestion retention value, the use of shrimp waste as a feed ingredient in broiler rations having problems because it have the rough khitin and high fiber. Ngoan et al. (2000) indicated that the amino acid composition of shrimp waste was fairly balanced, but the low methionine content can limit its value for mono-gastric animals. Other factors, such as high chitin and calcium contents, could limit the amount of shrimp waste in mono-gastric diets. Chitin is a linear polymer of N-acetyl-D-β glycocyamine unit linked (1,4) glycosidic bond (Minoru et al., 2002). Chitin physically block the access of digestive enzyme to proteins and lipids, thus affecting the ulitization of these nutrients, this results show in Oduguwa et al. (2004) which at high level of shrimp waste cause drop of growth rate and efficiency.

Processing to improve the nutritional quality of shrimp waste needs to be done to support its usage in poultry rations. Hydrolysis and fermentation treatment are treatment technology that can be done in the shrimp waste.

Chitin hydrolysis of shrimp waste chemicaly can also be done by using 6% of HCl, 3% of NaOH and 5% of H_2O_2. Biological processing can be done through fermentation process by using *Aspergillus niger*. Treatment of shrimp processing waste is expected to maximally increase the use of shrimp waste in broiler rations. The purpose of this study was to determine the quality of processed shrimp waste and its impact on consumption and feeding of protein retention in broilers.

Materials and Methods

Experiment was done in two phases. Phase one was preparing shrimp waste hydrolysis by NaOH 3%, HCl 6%, H_2O_2 5%, and fermentation by *Aspergillus niger*, then nutrient analysis. The proximate composition of shrimp waste is shown in Table 1. Shrimp waste is derived from by product of monodon shrimp freezing industry and is in the form of flour. Hydrolysis Procedure of shrimp waste is following the experiment conducted by Bastaman (1989), whereas for fermentation with *Aspergillus niger* is conducted following Nur (1989).

The second phase of the study was to test the use of shrimp waste in broiler rations. Broiler strains used is 202 MB - platinum produce by PT. Multibreeder Adirama Indonesia Tbk. The number of broilers are 20 at age 4 weeks with an average body weight of 555 ± 64.4 g/broiler. Rations used was the basal ration with the addition of shrimp waste powder. The basal ration consisting of yellow corn, pollard, coconut crumbs, soybean crumbs, lysine, and Premix. The nutrition of the basal and experimental diets are shown at Table 2.

Research carried out experimentally by using Completely Randomized Design with five treatments and four replications. Experimental treatment were as follows: D_0 (basal ration + 5% shrimp waste without treatment); D_1 (basal ration + 5% NaOH hidrolisat shrimp waste 3%); D_2 (basal ration + 5% HCl hidrolisat shrimp waste 6%); D_3 (rations Basal + 5% shrimp waste hidrolisat H_2O_2 5%); D_4 (basal ration + 5% shrimp waste by fermentation with *Aspergillus niger*).

Data was analized using analysis of variance, and followed by Least Significant Difference (LSD) test to compare between treatments at 5% significant level. Before taking data, prelium time was conducted for 3 days by providing rations and drinking water (*ad libitum*) in order for the chicken to be able to adapt. Furthermore chickens were fasted for 36 hours but still be given enough drinking water. Treatment given after the period of fasting by giving ration gradually. After 2 days, excreta was collected. Next protein content in the excreta was tested using Kjeldahl method.

The observed variables are: (1) consumption of protein (g/bird/day), measured by multiplying the number of consumed rations by broiler with protein content in the rations. (2) protein retention (%), obtained by calculating the difference between the amount of protein consumed and the amount of protein contained in the excreta, and comparing with the amount of consumed protein multiplied by 100%.

Results and Discussion

Refering to Table 1, it shows that processed nutritional shrimp waste were varies to have increased and decreased in nutrition content. The water content (%) of hydrolysis shrimp waste with the addition of NaOH 3% and HCl 6% was increased as a consequence the dry matter decreased. The hydrolysis and fermentation treatments can decrease crude fiber and increased crude protein, fat and ash of shrimp waste. This shows that the hydrolysis and fermentation treatment could break chitin in shrimp waste. These results were similar to

Table 1. Proximate composition of shrimp waste

Nutrients (%)	Shrimp waste	Hydrolysate with			Fermentation of *Aspergillus niger*
		NaOH 3%	HCl 6%	H_2O_2 5%	
Water	10.65	16.42	18.50	7.98	8.48
Dry matter	89.35	83.58	81.50	92.02	91.52
Crude fiber	19.82	15.43	16.58	19.00	12.76
Crude Protein	31.58	37.01	32.04	39.08	39.75
Fat	9.49	11.55	10.37	13.56	9.24
Ash	19.67	21.81	22.14	21.06	21.99
Gross Energy (kcal/kg)	4023.30	3801.59	3810.83	4024.98	3961.65

Table 2. The nutrition of basal and experimental of broiler diet

Components	Treatments					
	Basal	D_0	D_1	D_2	D_3	D_4
Water (%)	10.05	10.08	10.37	10.47	9.95	9.97
Protein (%)	20.20	20.77	21.04	20.79	21.14	21.18
Fat (%)	11.27	11.18	11.26	11.23	11.38	11.17
Crude fiber (%)	3.32	4.15	3.93	3.98	4.10	3.79
Gross Energy (kcal/kg)	4536	4510.37	4499.28	4499.74	4510.45	4507.28

D_0: basal ration+ 5% shrimp waste without treatment; D_1: basal ration + 5% NaOH hidrolisat shrimp waste 3%;
D_2: basal ration + 5% HCl hidrolisat shrimp waste 6%; D_3: basal ration + 5% shrimp waste hidrolisat H_2O_2 5%;
D_4: basal ration + 5% shrimp waste by fermentation with *Aspergillus niger*.
Means bearing different letters differ significantly (P<0.05).

what Mahata et al. (2008) and Nurhayati et al. (2006) found. But nutritional content and hydrolysis of shrimp waste were different from Mahata et al. (2008) or Djunaedi et al. (2009) found. This was due to the difference of origin and processing method of shrimp waste and shrimp type.

Table 3 show that the consumption of protein, 3% NaOH treatment was not significantly different from 5% H_2O_2 treatment. This is caused by the consumption of rations and protein content are not much different between the treatment NaOH 3% (125.48 g/bird/day) and H_2O_2 5% (123.82 g/bird/day).

Protein consumption of NaOH 3% treatment and H_2O_2 5% is significant higher than the control treatment, HCl 6%, and fermentation. This is due to the fact that NaOH treatment ration, 3% and 5% H_2O_2 have better palatability so that their feed consumption was also higher. The higher the ration the consumption the higher the consumption of protein and nutritional substances contained therein. At 3% NaOH treatment is known to have an increase in glutamic acid. Glutamic acid composition may lead flavor of the ration increased. For the treatment of H_2O_2 5%, the color of shrimp waste turn into a bright yellow so palatabiltas of this rations is increased. The treatment of protein consumption HCl 6%, Fermentation, and control was not significantly different. This is caused by the consumption of all three rations are not much different. Shrimp waste that is hydrolyzed by HCl 6% caused damage in its food substances so that its palabilitas of the rations were low.

Hydrolysis resulted in an acid environment caused amino acids become damaged due to deamination (bond stretching selectively) (Schumm, 1992). While low feed consumption in control feed thought to be caused by the high content of crude fiber and chitin (shrimp waste is bulky), and this trait is a limiting provision of shrimp waste as it can result in decreased consumption. Table 3 shows that the protein retention of H_2O_2 5% treatment was not significantly different from that of 3% Na OH treatment. This is due to the average consumption of protein treatment and chitin content were not much different on both rations. Protein and amino acid consumption have direct effect on protein retention (Corzo et al., 2005). The Similar protein retention indicates that protein quality of shrimp waste on 5% H_2O_2 treatment is equal to that of 3% NaOH treatment. Retention of proteins is one method for assessing protein quality of substance or rations (Trevino et al., 2000). Protein retention of 5% H_2O_2 and 3% NaOH treatments are higher than that of HCL 6%

Table 3. The effect of shrimp meal on feed consumption, protein consumption and protein retention

Parameters	Treatments				
	D_0	D_1	D_2	D_3	D_4
Feed consumptionn(g/bird/day)	98.91a	125.48a	104.08a	123.82a	96.03a
Protein consumption (g/bird/day	22.58a	29.46b	24.17a	29.07b	22.59a
Protein excreta	6.95a	7.23a	6.69a	6.49a	7.29a
Protein retention (%)	69.73ab	75.47c	72.35b	77.65c	67.88a

Table 4. Composition amino acid of shrimp waste and shrimp waste hydrolysis (NaOH 3%)

Parameters	Shrimp Waste [1)]	Shrimp Waste Hydrolysate (NaOH (3%) [1)]
Protein & N compound (%)	58.47	58.81
Amino acid :		
Aspartic acid	3.34	3.78
Glutamic acid	4.46	5.54
Serine	1.39	1.51
Histidine	0.34	0.27
Tyrosine	1.48	1.65
Methionine	0.52	0.57
Valine	1.54	1.92
Phenylalanine	1.62	1.65
Isoleucine	1.20	1.56
Lysin	1.64	1.66

1) Kurtini et al. (2008)

treatment, control, and fermentation. This is due to the average protein consumption of H_2O_2 5%, and NaOH 3% treatments are also substantiallyhigher.

Hydolysis by H_2O_2 5% and NaOH 3% suspected to be effective in chitin denaturation, so the amount of protein rentention by broiler is higher. Protein retention of control treatment was not significantly different from that of HCl 6% treatment and fermentation. This is caused by the consumption of protein and protein excreta are not significantly different. However, protein retention of HCl 6% treatment significantly higher that of fermentation treatrment. This is due to HCl 6% treatment could degrade khitin better than the treatment of fermentation could do, so that protein consumption is higher while protein excreta is lower.

Conclusions

(1). Processed shrimp waste has the potential to be used as a protein source in broiler ration; (2). Protein consumption and retention of hydroliysate shrimp waste (NaOH 3% and H_2O_2 5%) treatments were the best.

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References

Bastaman S. 1989. Studies on Degradation and Extraction of Chitin and Chitosan from Prowers Shells. The Queen's of Belfast. England.

Bath D, J Dunbar, J King , S Berry and S Olbrich. 2001. By-products and unusual feedstuffs. In: Feedstuffs 2001. 73: 30-37.

Corzo A, CA Fritts, MT Kidd, and BJ Kerr. 2005. Response of broiler chick to essential and non-essential amino acid supplementation of low crude protein diets. Anim. Feed. Sci. Technol. 118: 319-327.

Djunaedi IH, T Yuwanta, Supadmo, and Nurcahyo. 2009. Growth performance and digestive organ weight of broiler fed different levels of shrimp waste meal fermented with *Bacillus sp*. Media Peternakan 32(3):155-228.

Eruvbetine D, ID Tajudeen, AT Adesun and AA Olojede. 2003. Cassava (*Manihot esculenta*) leaf and tuber concentrate in diets for broiler chickens. Bioresource Technology 86: 277-281.

Gernat AG. 2001. The effect of using different level of shrimp meal in laying diets. J. Poultry Sci. 80:633-636.

Ingweye JN, BI Okon, JA Ubua, and AI Essien. 2008. Performance of broiler chicken fed fish and shrimp waste. Asian J. of Anim. Sci. 2(2): 58-63.

Khempaka S, K Koh, and Y Karasawa. 2006. Effect of shrimp meal on growth performance and digestibility in growing broilers. J. Poultry Sci. 43: 250-254.

Kurtini T, Muhtarudin, D Septinova. 2008. Penggunaan Hidrolisat Limbah Udang Sebagai Sumber Asam Amino Essensial dalam Upaya Optimalisasi Produksi Ayam Pedaging. Laporan Penelitian. Universitas Lampung. Bandar Lampung.

Mahata ME, A Dharma, I Ryanto and Y Rizal. 2008. Effect of substituting shrimp waste hydrolysate of Peneus merguensis for fish meal in Broiler. Pakistan J. of Nutrition 7(6): 806-810.

Nuraini, H Abbas, Y Rizal, and Y Marlinda. 2005. Pemanfaatan ampas sagu fermentasi kaya B karoten dalam ransum terhadap produksi dan kualitas telur ayam ras. J. Ilmiah Ilmu-ilmu Peternakan Jambi 8: 55-59.

Nurhayati, O Sjofjan dan Koendjoko. 2006. Kualitas nutrisi campuran bungkil inti sawit dan onggok yang difermentasi menggunakan Aspergillus niger. J. Pengembangan Peternakan Tropis 31(3):172-178.

Minoru, MS Hiroyuki and S Yoshihiro. 2002. Control of function chitin and chitosan by chemical modification. Glycoscience and Glycotecnology 14 : 205-222.

Ngoan LD, LV An, B Ogle and JE Lindberg. 2000. Ensiling techniques for shrimp by-products and their nutritive value. Asian-Austr. J. of Anim. Sci. 13:1278-1284.

Nur YS. 1993. Pengatur Kultur Campuran terhadap Peningkatan Nilai Gizi Onggok Sebagai Pakan Broiler. Tesis. Program Pascasarjana Institut Pertanian Bogor. Bogor.

Oduguwa OO, AO Fanimo, VO Olayemi and N Oteri. 2004. The feeding value of sun dried shrimp waste meal based diets starter and finisher broilers. Arch. Zootec. 53: 87-90.

Okoye FC, GS Ojewala and K Nijoku-Onu. 2005. Evaluation of shrimp waste meal as a probable animal protein source for broiler chickens. International J. Poultry Sci. 4 (7): 458-461.

Rofiq MN. 2003. Pengaruh pakan berbahan baku lokal terhadap performans vili usus halus ayam broiler. J. Sains dan Teknologi Indonesia 5(5): 190-194.

Schumm DE. 1992. Intisari Biokimia. Diterjemahkan oleh Moch. Sadikin. Binarupa Akasara. Jakarta.

Septinova D, T Kurtini, N Purwaningsih and Riyanti. 2009. Usage of treated shrimp waste in ration and its effects on broiler live weight, carcass, giblet and abdominal fat. J. of the Indonesian Tropical Animal Agriculture 34(2): 122-126.

Trevino J, ML Rodriguez, LT Ortiz, A Rebole, and C Alzueta. 2000. Protein quality of linseed for growing broiler chicks. J. Anim. Feed Sci. Technol. 84:155-166.